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Sergi Jimenez-Martin
Jose M. Labeaga
Cristina Vilaplana Prieto

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Award errors and permanent disability benefits in Spain*

Sergi Jiménez-Martín† José M. Labeaga‡ Cristina Vilaplana Prieto§

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Abstract

In this paper we estimate equations for deserving or "true disability indicator" and receiving disability benefits to evaluate the award error as the difference between both probabilities using survey data from Spain. As expected award errors are not randomly distributed across the population. We find that individuals aged between 55 and 59, self-employed, working in an agricultural sector or living in a depressed region, have a significantly higher probability of receiving a benefit without deserving than the rest of individuals. We also find evidence of gender discrimination since males have a significantly higher probability of receiving a benefit without deserving it. Finally we show that the probability of getting a benefit being healthy is not distributed at random across the population. We have estimated the cost of wrongful benefit concession at a minimum of 1500 million euros or 0,2 percent of the Spanish GDP for year 2000. All these findings confirm that disability benefits are being used as an instrument for exiting the labor market for individuals approaching the early retirement age. Since the awarding process depends on Social Security Regional offices, this implies that some regional offices are applying loosely the requirements for granting disability benefits.

JEL CODES: H55, J26

KEYWORDS: DISABILITY BENEFITS, AWARD ERROR, EARLY RETIREMENT, SOCIAL SECURITY

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†IAE, Universitat Pompeu Fabra, and FEDEA

‡FEDEA and UNED, Madrid

§Universidad Católica San Antonio de Murcia

1 Introduction

In this paper we study permanent disability benefits award policy in Spain in order to evaluate award errors and policies using data from the Disabilities, Deficiencies and Health Status Survey (DDHSS from now on). In a context of an ageing population and increasing shortage of labor supply this can be specially relevant in many developed countries, including Spain. In order to reverse these trends and get more work out of the near elderly (50+) individuals, it is important to understand the factors (either socioeconomic or health related) and policies behind benefit concession policies and award errors.

Disability benefits in many European countries are due to either "truly" medical reasons, to economic reasons and/or the combination of these two factors. One of the objectives of our exercise is to *tentatively* distinguish between them. For example, those in sample receiving a disability benefits which do not have any disability can be classified as receiving a benefit due to "economic reasons". Alternatively those receiving a benefit having some disabilities but of limited importance can be classified as receiving a benefit due to the combination of disabilities and economic reasons or policies. We put special emphasis in the detection of two major redistributive policies: firstly, a policy easing transitions to inactivity of older individuals; and, secondly, a policy favoring transitions to inactivity of workers in the less favored regions and thus transferring income from rich to poor regions. These policies are specially important in Spain since disability benefits are, ceteris paribus, more generous and they have a favorable fiscal treatment than other old-age benefits.

Regarding the first policy mentioned, it is well known that permanent disability benefits have been intensively used in Europe to ease transitions to retirement before the early retirement age, and Spain is not an exception (See Boldrin et al. (1999) for a comment of the Spanish case and the collection of papers in Gruber and Wise (1999) for illustration for other countries). Specifically for the Spanish case, Figure 1 plots the ratio of new disability benefits and new retirement benefits as well as the rate of growth of the Spanish GDP in the period 1976–2006. The negative relationship between both trends is clear: in bad times the ratio is relatively high, and in good times the relationship is just the opposite.[1] We center the analysis on individuals between 45 and 59 (just below the first age individuals are elegible for a retirement benefit), because for them the effect of this policy is much more evident. For example, in 2005, 55 (75) per cent of all disabled in the main regime of the Spanish Social Security were concentrated between age 45 and age 59 (45–64).

To illustrate the differences in regional prevalence of disability benefits we present in Table C.1 (Appendix C) the recent trends of the ratio in disability to retirement benefits by region. It is evident the great disparity of this ratio across Spanish regions which are relatively diverse in terms of development (see the last column of Table C.1) and growth. Thus, it becomes clear the need to audit Social Security awarding process of permanent disability benefits to determine what kind of social, political or administrative factors are responsible for the divergences observed.

While there are empirical studies in some countries providing evidence about disability benefits (for the US see, for instance, Bound, 1991; Kreider, 1991; Benítez-Silva et al., 2004 and 2005; Bound et al., 1999 using the Health and Retirement Survey), the lack of adequate data explains the absence of studies of this kind in Spain.[2] The recent disposal of the DDHSS carried out by the Spanish National Bureau of Statistics in 1999, whose results have recently been published, make it possible to conduct such an study in Spain.

According to the Social Security Law (Art. 136) an individual deserves a benefit if "after

[1] The drop in the ratio of disability benefits in 1985 is due to a change in the eligibility conditions to get a disability benefits include in the 1985 Spanish Social Security reform.

[2] For other European countries research in this area is also limited. For details and evidence about disability in some European countries, including Spain, see the collection of papers in Gruber and Wise (1999)

having received the prescribed treatment, presents anatomical or functional serious reductions, capable of objective and predictably definitive determination, that diminish or eliminates his labor capacity". Thus, it turns out that the fundamental issue is to have a precise and trustworthy measure of what is understood by deserving a disability benefit. The idea that lies behind the concept of disability is not exempt from a high degree of subjectivity. Many studies have used self-reported health and disability measures (Boskin and Hurd, 1978; Gordon and Blinder, 1980; Hanoch and Honig, 1983; Berkovec and Stern, 1991). Others have argued that these indicators are not appropriate for measuring working limitations (Zabalza et al., 1980; Chirikos and Nestel, 1984; Bazzoli, 1985; Bound, 1991; Bound et al., 1995; Bound and Burkhauser, 1999). The most common view is that some survey respondents may inflate the incidence and severity of health problems in order to increase the probability of receiving a disability benefit (Burkhauser, 1979; Parsons, 1980 ; Anderson and Burkhauser, 1985; Kerkhofs and Lindeboom, 1995). On the other hand, Stern (1989), Dwyer and Mitchell (1999) and Benítez-Silva et al., (2004 and 2005) conclude that self-reported measures are reasonable indicators of health status.

One of the main contributions of this paper is the design of a disability indicator to evaluate whether an individual deserves a permanent disability benefit. In the Disabilities Questionnaire from the DDHSS, respondents are required to enumerate all disabilities suffered according to a established classification of 36 disabilities. Fixing a threshold of severity and expected evolution of the disability, it is possible to determine whether an individual deserves a disability benefit. For this purpose, we adopt the definition of what the Social Security understands for permanent disability, and use it as an standard according to which individuals determine their level of disability. Although we agree that some individuals may have incentives to misreport their disability status and to exaggerate health problems when applying for a benefit, these incentives may disappear when answering a survey in which confidentiality is guaranteed. We will propose up to six disability indicators and will perform exogeneity, and choose among them, following Benítez-Silva et al (2005) on the basis of a battery of tests. The surviving indicator(s) can be interpreted as the Social Security decision with perfect information and without any policy consideration.[3]

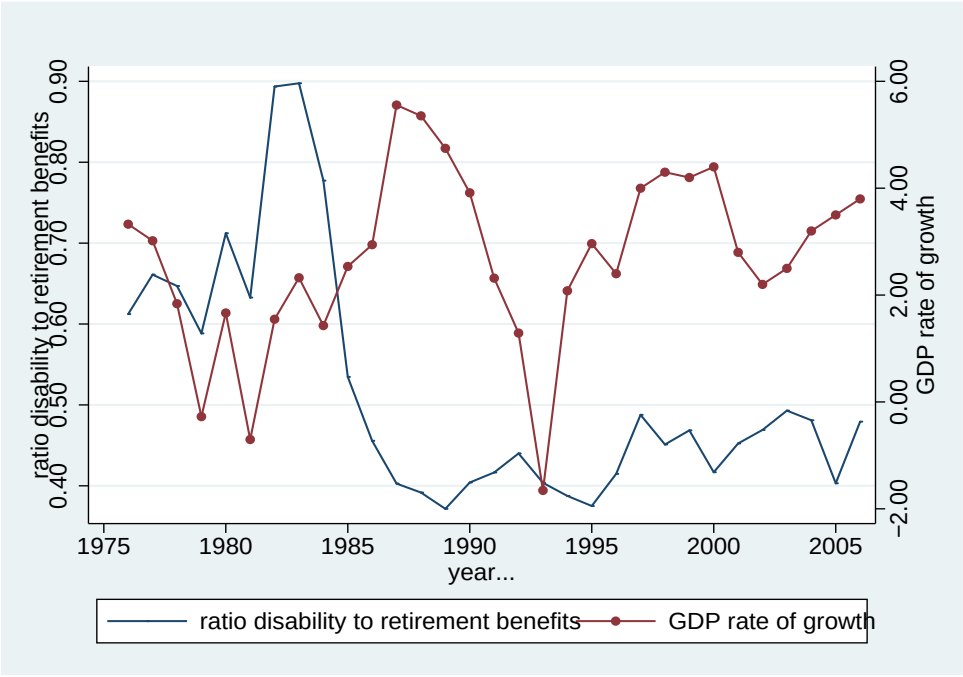
Our work is related with those of Benítez-Silva et al. (2004, 2005), who compare objective, official data on disability with self-reports. In their work, under the assumption that the official data are correct, the hypothesis that self-assessed health is an unbiased indicator of the disability insurance award decisions cannot be rejected. On the other hand, Baker et al. (2004) have come to a rather different result, where self-reported measures, i.e., survey reports on chronic ailments are measured with considerable error compared to medical reports.

To measure the award error we compare two variables: the Social Security awarding decision, and the deserving or "true disability status" indicator designed according to the legal text. Using information for a set of individuals about whether they receive a disability benefit, and introducing the disability criteria to determine if they deserve or not, we can estimate the joint distribution of the variables *receiving* and *deserving*, from which an award error can be derived. It is convenient to note that the award error is not the same than the error type II. The first refers to the probability of not deserving a benefit conditional on receiving it, and the second refers to the probability of receiving a benefit conditional on not being disabled.

Our results indicate that individuals aged between 55 and 59, self-employed or working in an agricultural sector have a probability of receiving a benefit without deserving it or *award error* significantly higher than the rest of individuals. Moreover the average estimated award error for this group is 20.31 percent, 36 and 115 percent larger than it is for the 50-54 and the 40-44 age

[3]We face a situation of asymmetric information with a completely informed principal (the individual) and an agent with incomplete information (the Social Security). The existence of hard-to-diagnose conditions may make it much more difficult for Social Security to tag those unable for work from those that are able bodied because of the imperfect information about the nature of the disability, generating a moral hazard problem.

Figure 1: Ratio new disability to retirement benefits and rate of growth of the GDP. 1976–2006.



groups, respectively. This confirm that disability benefits are being used as an instrument for exiting the labor market for those who do not wish to wait until the early retirement and face the age penalties, or those who do not have right to early retirement because are affiliated to special regimes (see Boldrin et al, 1999 for a description of Social security rules and regimes and the incentives generated by them). We also find significant regional differences in award error with and without disabilities (again, see Boldrin et al., 1999, for earlier evidence).

The structure of the rest of the paper is as follows. In section 2 we explain briefly the characteristics of the Spanish disability system, we review literature of disability measures, and describe the construction of a set of alternative deserving or "true disability status" indicator. The economic and econometric setup for the analysis is presented in section 3. Also in this section we describe the data and perform several specification diagnostics. In section 4 we present the main estimation results. In section 5 we propose an alternative mechanism for awarding disability benefits. Finally, in section 6 we conclude with some policy implications.

2 Disability in Spain: concept, benefits, and measurement

2.1 Concept of disability

Permanent disability is the situation of a worker that, after going through the prescribed treatment and being released from medical care, still presents serious anatomical or functional reductions, susceptible of objective determination and predictably permanent, that diminish or impede their ability to work. The possibility of eventually recovering the ability to work will not be an obstacle to this classification if such a possibility is estimated as uncertain or very long term by a medical team.

The disability situation may be reviewed due to worsening, improvement, or misdiagnosis of the condition, or due to carrying out work while the disabled person is still under 65 years of age. It can lead to the confirmation or modification of the degree of the disability, or the

termination of the disability consideration, and therefore, of the disability benefits.

Disability benefits

The Spanish Social Security system provides insurance against both temporary and permanent illness or disability.

Temporary illness or disability The terms of provision of the subsidy for temporary illness or disability (*incapacidad laboral transitoria*) has undergone frequent changes. Eligibility requires affiliation to the system for a minimum period that depends upon the nature of the covered risk. Common illness requires only 180 days of contributions during the last 5 years, whereas no minimum eligibility criterion is imposed for work-related accidents or illnesses.

The benefit base depends on actual earnings during the last 12 months. In case of common illness or work-unrelated accident, the subsidy is equal to 60 percent of the benefit base for each day of absence between the 4-th and the 20-th, and to 75 percent thereafter until the maximum period (18 months) is reached. After this period the worker must either return to work or, conditional on passing a medical examination, be classified as "permanently disabled".

Permanent disability pensions Contributory disability benefits (DI) are far more generous than any other old-age program, since they are not subject to penalties for young age or insufficient years of contribution. DI benefits are subject to approval by a medical examiner (notoriously, the tightness of the admissibility criteria used by examiners varies both over time and across regions) and, since the early 1990s, they have become harder to obtain at older ages [see Boldrin et al (1999) for further details].[4]

Disability pensions are distinguished into contributory and non-contributory. They are converted into retirement pensions once the beneficiaries turn 65 years of age, but keeping a very favorable tax treatment. Eligibility and pension amounts depend on the level of disability. The 1985 reform distinguished four levels of permanent disability characterized by increasing severity. Since then, the legislation has formally reduced them to three, but it has also created a special subcase of the first level with the explicit purpose of using the disability funds to subsidize the dismissal of old workers from certain sectors or geographical areas. The first level (*incapacidad permanente total para la profesión habitual*, or IPT) corresponds to inability to do the usual job. A special subcase (*incapacidad permanente total cualificada para la profesión habitual*, or IPTC) applies only to employees older than 55 which are in particular socioeconomic situations. The second level (*incapacidad permanente absoluta*, or IPA) corresponds to inability to do any kind of job. The third level (*gran invalidez*, or GI) requires, in addition, continued attendance by other persons in order to carry out the basic vital functions. In terms of requirements, when disability is caused by an ordinary illness, eligibility to a pension requires from 5 to 15 years of contributions, depending on age. There is no contributive requirement when the disability is caused by an accident, whether or not work-related, or a professional illness.

The benefit base depends on the source of disability. In case of ordinary illness, it is computed as for old-age pensions. For work-unrelated accident, it is the average annual wage over a period of 24 consecutive months chosen by the person within the last 7 years of work. For work-related accident or professional illness, it is the average wage in the last year of work. The pension equals 55 percent of the benefit base under IPT, and increases to 75 percent under IPTC. In

[4]It is the responsibility of the Provincial Directorates of the INSS through the Disability Evaluation Teams and in every stage of the procedure, to declare the Permanent Disability condition so benefits may be assigned. The Provincial Directorate of the INSS will issue a resolution in a maximum of 135 days. If no resolution has been issued within this deadline, the application shall be deemed denied by way of negative administrative silence. If it is necessary to ask for a hearing or if complementary documentation is requested, the interested party will have 10 days to argue his case or present the documentation.

case of IPA, it is equal to 100 of the benefit base, whereas for GI it is equal to 100 percent of the benefit base plus another 50 percent covering the person taking care of the disabled.

2.2 Disability measures

Labor capacity is an important determinant of labor behavior and affects the retirement decision and the application for disability benefits. Most people argue that one of the crucial reasons for retiring before the normal age is poor health status. However, several reasons can lead us to suppose that self-reported measures are biased. Anderson and Burkhauser (1984) pointed that searching for good disability measures is one of the open questions in the study of older workers labor behavior. The true disability status is an unobservable variable, but different measures can be used to approximate it. In general, disability measures can be classified into two groups:

Objective measures: they are not based on self-reported health status and do not present, as a rule, endogeneity problems. Mortality rates, number of days of work lost because of illness or body mass index are some examples.

Subjective measures: we can distinguish between global and specific subjective measures.

1. **Global measures** are based on self-reported health status. They are normally recorded according to questions like: how would you define your health status: excellent, good, regular or bad? Do you think that the quantity or quality of work you do is affected by some problem of health or disability?

   Anderson and Burkhauser (1984), Bound (1991) and Waidman et al. (1995) indicated that these measures have several problems. First of all, they are based on personal judgements of health status and it is very difficult to compare answers from different individuals. Second, self-reported measures may not be independent of what we are trying to explain. The main reason is that some survey respondents may inflate the severity of their health problems in order to rationalize their relation with economic activity (p.e. unemployment).

   However Benítez Silva et al. (2004, 2005) define a variable called "true disability" if the individual considers that he suffers any impairment or health problem that limits the amount of work he can do. They use this measure for identifying type I and type II errors in permanent disability benefits (rejection and award errors respectively). Bound and Burkhauser (1999) and Bound and Waidmann (1992) criticize this definition because those individuals who apply for a benefit, and those who are receiving it may have incentives to exaggerate health problems. Finally, sometimes individuals unable to continue working may apply for early retirement. Then, those with a high relative value of leisure are going to have financial incentives to identify themselves as disabled.

2. **Specific measures**, which are self-reported measures based on specific conditions of the individual. Cardiovascular illnesses or vertebral column deficiencies are good examples of this type of variables, which are less prone to suffer systematic errors than global subjective measures. This kind of measures can be used as indicators of health status in a participation equation (Bound et al., 1995). However, this strategy is not very common and specific measures are often used as instruments for global subjective measures (Stern, 1989; Bound et al., 1998). The limitation of the method proposed by Stern (1989) is that the influence of other economic variables over retirement decisions is left unidentified. The implicit assumption when using this technique is that self-reported health status is insensitive to psychological and monetary incentives. Finally, Rice et al (2006) estimate a latent health index by means of a generalized ordered probit that captures a fraction of the reporting bias.

The choice of the disability measure is very important because it may bias the results obtained (Anderson and Burkhauser, 1984). Endogeneity problems are going to overestimate the impact of health status over labor force participation, while measurement errors are going to underestimate this effect. However, these biases operate in opposite directions and controls can be implemented to obtain upper and lower thresholds for the effect of reported disability over labor behavior (Bound, 1991).

2.3 Design of the disability indicator

In this section we present several alternatives in order to determine whether an individual deserves a permanent disability benefit using the DDHSS survey. The survey defines a disability as any serious limitation that affects for more than one year the activity of the individual and that has its origin in a deficiency. Therefore, a respondent is considered to be not disabled if he does not have any difficulty in achieving any of 36 daily living activities (see the appendix for details). So the above definition is based on the individual's subjective perception of her own limitations.[5] The concept of disability relies on the idea of deficiency as the only possible origin of the disability, that is to say, it analyzes whether the individual is capable of performing a determined activity independently if he really practices it or not. It is also necessary to bear in mind that the same person can be affected by two or more disabilities that can be independent among them, originated by different deficiencies or by the same one.

The Spanish legislation applies the professional disability principle to determine who deserves a benefit. This principle takes into account three factors: the set of sequels, ailments and diseases, the occupations affected by limitations, and the particular effect on each individual (Barba Mora, 2001). It is not possible to consider the second factor because we do not know the occupation for pensioners without disabilities. As regards to the third factor it is impossible to consider in a model variables such as resistance to pain and personality, which are genuinely unobservable. In order to relieve this disadvantage we are going to restrict the analysis to survey respondents from 45 to 59 years old. This means that we only require elements of pathological character. The determination of the degree needed to establish permanent disability would require a very deep medical knowledge. Since we do not rely on this information, we will only look at the external symptoms of the deficiencies, i.e., we focus on disabilities. For each disability we are going to fix a threshold of severity, prognosis and origin and will assume that an individual deserves a disability benefit when passing the threshold.

In order to be as exhaustive as possible we design six different criteria for deserving a disability benefit of increasing complexity (see Table 1 for a description of the criteria). We construct them on the basis of tree criteria: severity, evolution, or origin of the each deficiency. Each criterion is represented by a binary indicator that takes the value one it the individual satisfies the criterion and value zero otherwise. Afterwards we choose the best criterion for estimating the model using exogeneity and consistency tests for each of the variables. We assume that individuals who have not answered the Disabilities and Deficiencies Questionnaires do not suffer any kind of health problem, so all criteria take the value zero for them.

3 Economic and econometric framework

After receiving an invalidity shock the individual goes to temporary illness/invalidity benefits. The invalidity shock causes a decrease in the individual earnings potential. In particular, we consider that the wage process w is shifted downwards by the health shock ($w_t = w_* h_t, h \leq 1$)The individual may recover (partially) or not but the degree of recovery is not observable to the Social

[5] All disabilities are investigated even if they are overcome with the use of some technical help. See the appendix A for details.

Table 1: Six alternative criterion for deserving a disability benefit

	Criterion 1	Criterion 2	Criterion 3	Criterion 4
Severity	Can present one of the following degrees: • Serious difficulty • Cannot do the activity	Same requirement of severity than criterion 1.	Same requirement of severity than criterion 1.	Same requirement of severity than criterion 1.
Forecast	Can present one of the following degrees: • Stable, without perspectives of improvement • Can go worse • It's not possible to determine	Can present one of the following degrees: • Recoverable with restrictions • Stable, without perspectives of improvement • Can go worse • It's not possible to determine	Same requirement of forecast than criterion 1.	Same requirement of forecast than criterion 2.
Origin	All except congenital and problems in the childbirth	All except congenital and problems in the childbirth	All	All
Objective	We consider disabilities with a high degree of severity and unfavorable forecast			

	Criterion 5	Criterion 6
Severity	Can present one of the following degrees: • Moderate difficulty • Serious difficulty • Cannot do the activity	Same requirement of severity than criterion 5.
Forecast	Same requirement of forecast than criterion 1 and when severity is moderate we consider that forecast may be: • Can go wose • It's not possible to determine	Same requirement of forecast than criterion 2, and when severity is moderate we consider that forecast may be: • Can go worse • It's not possible to determine.
Origin	All except congenital and problems in the childbirth	All
Objective	We include degenerative diseases (Parkinson, Alzheimer)	

Security. After exhaustion of temporary benefits, the individuals decides whether to apply or not. However, since the application process is unobservable, we assume that all the individuals with disabilities apply for a disability pension.[6] If the application is accepted, the individual receives a benefit until death (T). Alternatively, when the application is rejected he has to return to work at a lower expected wage until retirement age (τ).

Under these circumstances the expected income of returning to work (EY_W) is equal to the utility of labor earnings (w) until retirement age plus retirement benefits (RB) from that moment till death, where Υ denotes the time passed from one moment to another.

$$EY_W(t) = w_t \Upsilon(t, \tau) + RB\Upsilon(\tau, T)$$

We follow Lumsdaine et al. (1997) to specify the utility function. Let U denote the utility function and suppose that it has two components: an observed systematic component and an unobserved stochastic component.

The expected utility if continue working (EU_W) can be expressed as follows:

$$EU_W(t) = \sum_{s=t}^{T} \pi(s|t)\beta^{s-t}[(EY_W)^{\gamma} + u_t]$$

where $\pi(s|t)$ denotes the probability of surviving to period s given survival to period t, β is the discount factor and u is a random component.

[6] The application process has several advantages and practically no cost.

The expected income (EY_A) in case of applying for disability benefits at time t is given by:

$$EY_A(t) = [a_t DB_t + (1 - a_t)w_t]$$

where a_t is the probability of getting the disability benefits ((DB)), and w denotes the wage if the application is rejected. Then expected utility of applying for disability benefits (EU_A) is:

$$EU_A(t) = \sum_{s=t}^{T} \pi(s|t)\beta^{s-t} \left[\mu^\gamma EY_A(t)^\gamma + v_t\right]$$

where μ represents the relative value of income in the post-application state to income in the pre-application state (income may produce more or less utility after application for disability benefits) and v is a random component.

An individual applies for disability benefits if $EU_A > EU_w$, or:

$$\sum_{s=t}^{T} \pi(s|t)\beta^{s-t}[\mu^\gamma EY_A(t)^\gamma - EY_W(t)^\gamma] - \sum_{s=t}^{T} \pi(s|t)\beta^{s-t}\omega_t > 0$$

where, $\omega_t = v_t - u_t$. Finally, the probability of applying for disability benefits at time t is given by:

$$\Pr[\textit{Apply at } t] = \Pr[\sum_{s=t}^{T} \pi(s|t)\beta^{s-t}[\mu^\gamma EY_A(t)^\gamma - EY_W(t)^\gamma] > \sum_{s=t}^{T} \pi(s|t)\beta^{s-t}\omega_t]$$

3.1 Econometric framework

Our econometric framework is based on a two-equation latent variable model. [7] We define two latent unobservable variables corresponding to Social Security's decision of awarding a permanent disability benefit, r^*, and to the true disability status, d^*.

$$r^* = X'\beta_r + \varepsilon_r$$

where X is a vector of characteristics observed by the Social Security administration, and β_r is the corresponding vector of parameters. The term ε_r can be can be understood as a "bureaucratic" noise that interferes the assignment process, and it is known by the Social Security, but unknown by the applicant. So $X'\beta_r$ is the score the applicant gets according to Social Security rules using a continuous scale. Applicants with a high score (without loss of generality we can say greater than zero) will receive a disability benefit. Instead of r^* we observe a binary indicator $r = \mathbf{1}(r^* > 0)$.

To represent if the applicant deserves a permanent disability we use a similar specification:

$$d^* = Z'\beta_d + \varepsilon_d$$

where Z is a set of variables that measure health status and β_d is the corresponding vector of coefficients or "weights". The term ε_d gathers some information that is only known by the applicant and not by the Social Security administration. As before, instead of d^* we observe the binary indicator $d = \mathbf{1}(d^* > 0)$. We additionally assume that $(\varepsilon_r, \varepsilon_d)$ are distributed as a bivariate normal with zero mean vector, variances normalized to one an correlation coefficient $\rho \in (-1, 1)$.

We could, a priori, think that the set of variables X and Z have to be the same. This is true for variables related to disabilities and deficiencies, but there are some variables that

[7] See Benítez-Silva et. al, (2005) for a more sophisticated version of this models .

can affect the probability of receiving and not the probability of deserving. For example, after controlling for other observables the region of residence should have no effect in either equation. However, since the assignment process depends on Social Security Provincial Departments, some differences in the level of exigency of disability requirements can emerge.

As there are only four combinations for the variables r and d, the likelihood function can be written in terms of a multinomial distribution:

$$\begin{aligned} p_{11} &= L(r=1,d=1|\beta_r,\beta_d,\rho,X,Z) \\ p_{10} &= L(r=1,d=0|\beta_r,\beta_d,\rho,X,Z) \\ p_{01} &= L(r=0,d=1|\beta_r,\beta_d,\rho,X,Z) \\ p_{00} &= L(r=0,d=0|\beta_r,\beta_d,\rho,X,Z) \end{aligned}$$

$$L(r,d|\beta_r,\beta_d,\rho,X,Z) = \prod_{\substack{r=1\\d=1}} p_{11} \prod_{\substack{r=1\\d=0}} p_{10} \prod_{\substack{r=0\\d=1}} p_{01} \prod_{\substack{r=0\\d=0}} p_{00}$$

This likelihood function can also be expressed as:

$$\begin{aligned} L(r,d|\beta_r,\beta_d,\rho,X,Z) &= \prod_{\substack{r=1\\d=1}} \Phi_2(X\beta_r, Z\beta_d, \rho) \prod_{\substack{r=1\\d=0}} \Phi_2(X\beta_r, -Z\beta_d, -\rho) \\ &\quad \prod_{\substack{r=0\\d=1}} \Phi_2(-X\beta_r, Z\beta_d, -\rho) \prod_{\substack{r=0\\d=0}} \Phi_2(-X\beta_r, -Z\beta_d, \rho) \end{aligned}$$

where Φ_2 denotes the bivariate normal distribution function.

3.2 Description of the data and sample

As stated, our main data source is the Disabilities, Deficiencies and Health Status Survey (DDHSS) carried out by the Spanish National Bureau of Statistics in 1999. A sample of 70,402 households and 218,185 people were interviewed, from which 10,484 were less than 6 years old and 207,701 were 6 or more years. [see the Appendix A for further details on survey characteristics and Appendix B for a description of disabilities and the variables employed in the empirical analysis.] We apply several filters to the original file in order to get the relevant samples for the purposes of our study (see Table 2 for a summary):

1. Initial sample (sample A): We select individuals in the 45–59 age range, for which disability is likely to constitute a pathway to a permanent exit from the labor force. However, we keep observations for younger individuals to draw comparisons with older individuals and make more evident the various policies in place. The surviving sample has 19442 males and 20489 females.

2. Restricted initial sample (sample B): we apply the following restrictions to sample A:

   (a) We eliminate individuals without a contributive career.

   (b) We eliminate the individuals that are working but whose professional situation is unknown.

   This leaves a sample of 18235 males and 8142 females. In these samples there are individuals with and without disabilities and we are going to use them for exogeneity and

Table 2: Description of the samples

Sample	Characteristics	Gender:Size	Purposes
A	Individuals aged 45–59	Men: 19442 Women: 20489	Screening mechanism
B	+ some requirements on economic activity	Men: 18235 Women: 8142	Exogeneity and consistency test Bivariate probit
B1	Ind. with disabilities + requirements on LFS	Men: 984 Women: 552	Rational expectations test Bivariate probit
B0	Ind. w/ disabilities + requirements on LFS	Men: 16980 Women: 7461	Prob of receiving being healthy

consistency tests.[8]

3. Sample with disabilities (sample B1). This sample is constructed by applying the following criteria to sample B:

   (a) We drop all individuals that do not answer the Disabilities Questionnaire.

   (b) From the sample of individuals who receive a permanent disability benefit and answer the Disabilities and Deficiencies Questionnaire we eliminate 145 observations for which we do not know the occupation and 255 observations for which we do not know the labor force status before receiving the benefit.

   In this sample, we define a binary variable that takes the value one if the individual is receiving a contributive permanent disability benefit.[9] That leaves a sample of 984 men and 552 women.

4. Sample without disabilities (sample B0): those observations in sample B which are not assigned to sample B1, excluding those deleted at previous stages, are assigned to sample B0. The resulting sample consist of 16980 males and 7491 females.

4 Choice of the "true disability status" or deserving indicator

With the purpose of determining which one of the six disability indicators previously defined best represents the legal benchmark of permanent disability given by the Social Security we perform three diagnosis tests. The surviving indicator will be used in the estimation of the permanent disability benefit award rate.

4.1 Exogeneity test

As already mentioned before, the exogeneity of self-reported disability status is quite controversial. Before estimating the model and using the results with policy purposes, we would like to be sure that the deserving indicator is strictly exogenous. We use Heckman's (1978) proposal

[8] Those individuals who do not suffer any disability do not answer to the Disabilities and Deficiencies Questionnaire. We do not know if they have an impairment certificate, need a caretaker, have finished a rehabilitation treatment or have changed of house because of a disability. But we suppose that the answer to all these questions is negative because otherwise they would have filled in the questionnaire.

[9] However this situation is not incompatible with an active labor force status. For example, 6.43% of men and 2.02% of women are also working and 2.66% of men and 0.81% of women are looking for a job.

using a two equation system to make such a test. The first structural equation represents the Social Security award decision and the second one indicates whether the individual deserves a disability benefit:

$$\begin{aligned} r_i^* &= X_{1i}\beta_1 + d_i\alpha_1 + u_{1i} \\ d_i^* &= X_{2i}\beta_2 + u_{2i} \end{aligned}$$

where r^* and d^* are two latent continuous variables, $X_j, j = 1, 2$ are vectors of exogenous variables referred to disabilities and deficiencies, and (u_1, u_2) are jointly normal with zero mean vector, variances normalized to one and correlation coefficient $\rho \in (-1, 1)$. To achieve identification we follow a two step procedure: we, first, regress both the deserving and receiving indicators over the set of disabilities and deficiencies; in a second step we drop the variables with non-significant coefficients. After imposing these exclusion restrictions, we estimate a bivariate probit using the restricted initial sample (sample B). In this context the exogeneity of the deserving equation can be checked by means of the test $\rho = 0$.[10]

Another possibility to test exogeneity of the deserving indicator is the Lagrange multiplier test. Under the null of exogeneity, the model is composed by two independent probit equations and bivariate probabilities and densities coincide with the product of the corresponding marginal ones. To construct the test we follow Kiefer (1982) and Greene (1993).[11] First, we define $\delta_{1i} = \gamma_{1i}\beta_1' X_{1i}$ and $\delta_{2i} = \gamma_{2i}\beta_2' X_{2i}$ where $\gamma_{i1} = 2r_i - 1$ and $\gamma_{i2} = 2d_i - 1$, r and d are the binary indicators of the events $\mathbf{1}(r^* > 0)$ and $\mathbf{1}(d^* > 0)$, respectively. Given this notation the joint log-likelihood can be written as

$$L^* = \ln\ L = \sum_{i=1}^{n} \ln \Phi_2(\delta_{1i}, \delta_{2i}, \rho^*)$$

where $\rho^* = \gamma_{i1}\gamma_{i2}\rho$. The LM or score test is a quadratic form which uses the first derivatives of the unrestricted likelihood function whose weighting matrix is the inverse of the information matrix for the unrestricted likelihood function when both equations are evaluated under the null. The statistic is distributed according to a χ^2 with one degree of freedom.

$$LM = (\frac{\partial L^*}{\partial \theta'})'(\frac{\partial^2 L^*}{\partial \theta \partial \theta'})(\frac{\partial L^*}{\partial \theta'});\ \theta = (\beta, \rho)$$

Substituting we get:

$$\begin{aligned} LM &= \frac{f^2}{h} \\ \text{where } f &= \sum_i \gamma_{1i}\gamma_{2i} \frac{\phi(\delta_{1i})}{\Phi(\delta_{1i})} \frac{\phi(\delta_{2i})}{\Phi(\delta_{2i})} \quad \text{and} \quad h = \sum_i \frac{[\phi(\delta_{1i})\phi(\delta_{2i})]^2}{\Phi(\delta_{1i})\Phi(-\delta_{1i})\Phi(\delta_{2i})\Phi(-\delta_{2i})} \end{aligned}$$

Table 3 reports the exogeneity test by gender for the set of criteria defined. We cannot reject the null of exogeneity for indicators 3 to 6 in the case of men and for any criterion in the case of women, at standard significance levels. This implies, for the case of men, that those indicators who consider disabilities with highest levels of severity and excludes congenital and childbirth problems as possible origin of the deficiency, are rejected. Consequently, a preferred disability criteria should be capable of gathering degenerative pathologies whatever origin they could have.

[10] Endogeneity of the regressor coupled with measurement errors would lead to inconsistent estimations (Benítez-Silva et al., 2004, 2005).

[11] See Rivers and Vuong (1988) for an exogeneity test in probit models. Recently, Fabbri et al (2005) discussed the statistical properties of LM test and other alternatives in simultaneous discrete choice models.

Table 3: Exogeneity test on the restricted initial sample (sample B).

	Men [N=18.235]		Women [N= 8.142]	
	Statistic	p-value	Statistic	p-value
Criterion 1	6.6919	0.0071	2.5732	0.2698
Criterion 2	5.2417	0.0299	1.6519	0.4846
Criterion 3	2.4496	0.2936	1.2539	0.6020
Criterion 4	1.1703	0.6282	0.6004	0.8136
Criterion 5	0.9991	0.6829	0.0085	0.9976
Criterion 6	0.0172	0.9951	0.0032	0.9990

4.2 Consistency test

[REWRITE] The second diagnosis refers to consistency. We want to verify if what individuals believe to be disabled is, coincides, in expected terms, with Social Security actual definition of permanent disability. Therefore, we test whether the deserving indicator based on self-reported disability status is an unbiased estimator of the permanent disability award indicator. We test that:

$$E[r - d|X] = 0$$

where X is the same vector of 36 disabilities and 27 deficiencies used for the exogeneity test. Unbiasedness can be tested through different ways. First, we can regress, by LS, $(r-d)$ on a set of explanatory variables and test the hypothesis that all coefficients are equal to zero. Second, using a multinomial logit model we can regress $(r-d)$ over the same set of explanatory variables and test the same hypothesis using a likelihood ratio test against a restricted model which only includes a constant. Finally, we can perform a likelihood ratio test using the results of a probit model of $|r - d|$ on a set of variables against a restricted probit model which only includes a constant term. In all three cases we use the restricted initial sample or sample B.

The results of the test are reported in Table 4. We have only carried consistency test for criteria 3 to 6 because of criteria 1 and 2 did not satisfy exogeneity and we are looking for a valid disability indicator for both men and women. For men, only criterion 6 satisfies all consistency tests, and for women both criteria 5 and 6 are valid under the results of these diagnostics. Therefore, in what follows we use criterion 6 both for men and women. This implies that the only surviving disability indicator is the one that considers all possible origins of the deficiency and includes moderate disability associated with an unfavorable prognosis.

4.3 Unbiased individuals' disability evaluation test

The results of the previous sections suggest that the deserving indicator based of self-reported disability status is an exogenous determinant and consistent estimator of the Social Security award decision. However, the tests presented above are based on asymptotic properties of the relevant test statistics, but in small samples they might have a very low power. Our key hypothesis is that applicants have a through understanding of the award process, including full knowledge of the weights β_r that Social Security places on various characteristics X, so the null hypothesis that we want to test is:

$$\beta_r = \beta_d$$

Table 4: Consistency test. Restricted initial sample (sample B).

		Men (N=18235)							
		Criterion 3		Criterion 4		Criterion 5		Criterion 6	
		Stat	p-val	Stat	p-val	Stat	p-val	Stat	p-val
OLS	$F_{(63,18171)}$	1.76	0.0002	1.76	0.0002	1.36	0.0313	1.01	0.4525
Probit	χ^2_{63}	86.81	0.0251	89.20	0.0166	96.66	0.0041	73.40	0.1740
M Logit	χ^2_{63}	93.20	0.0080	95.55	0.0051	104.47	0.0008	81.44	0.0590
		Women (N=8142)							
OLS	$F_{(63,8078)}$	1.47	0.0097	1.57	0.0028	1.27	0.0736	1.15	0.1920
Probit	χ^2_{63}	93.55	0.0075	92.06	0.0099	51.22	0.8560	52.97	0.8122
M Logit	χ^2_{63}	99.72	0.0022	98.55	0.0028	52.97	0.8122	63.12	0.4720

Table 5: Rational expectations test. Restricted initial sample (sample B1).

	Test $\hat{\beta}_r = \hat{\beta}_d$	p-val
Men (N=984)	χ^2_{48} =48.10	0.4689
Women (N=552)	χ^2_{48} =54.98	0.1981

If the rational expectations hypothesis holds, the deserving indicator constitutes a valid measure of the degree of disability required for receiving a disability benefit, and it can be used to measure the magnitude of the classification errors in the permanent disability benefits award process[12].

Table 5 provide the results for the sample of men and women that have declared to suffer some disability (sample B1). We have estimated a bivariate probit model in which we have included as explanatory variables the same disabilities and deficiencies for the Social Security and for the applicant's equation. For both samples we cannot reject, at standard significance levels, the null hypothesis that the corresponding vector of parameters are equal.

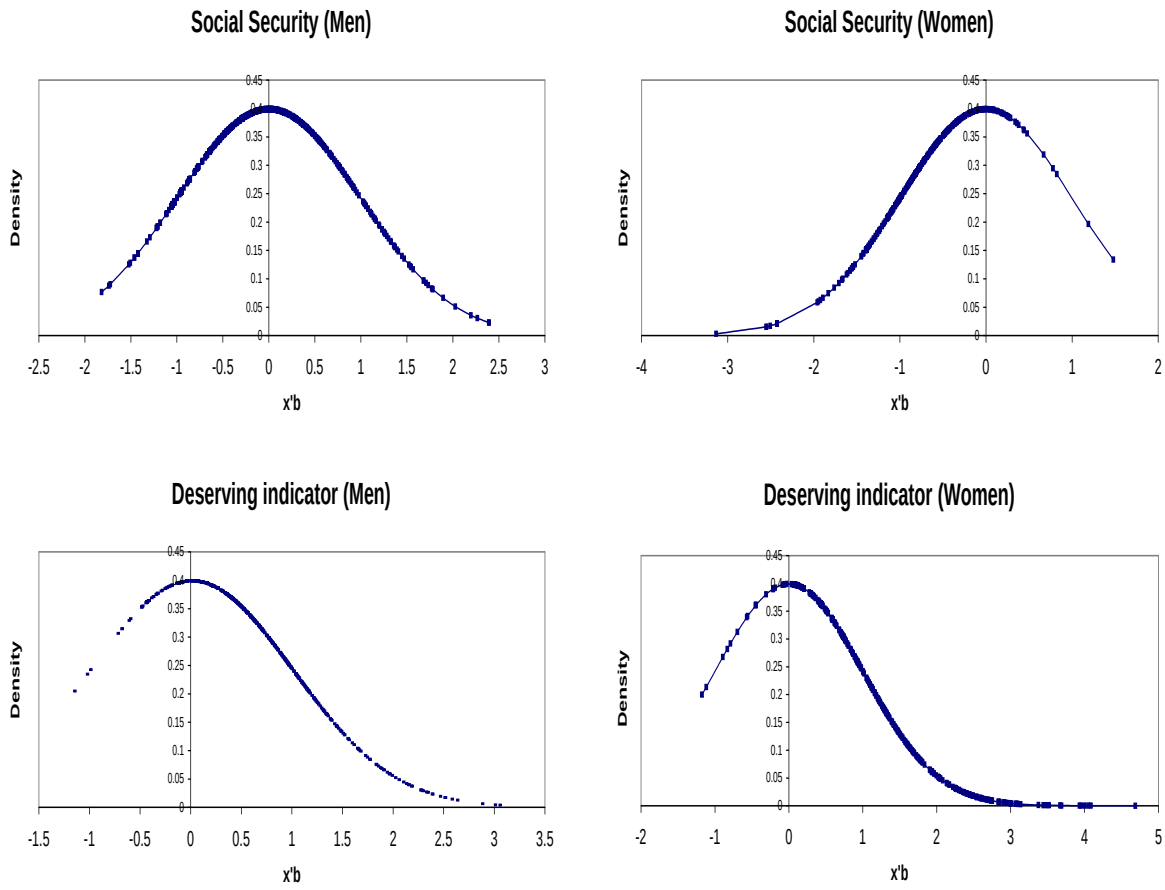
In Figure 2 we plot the estimated density functions for both the awarding and deserving decisions by gender. Note that that the deserving density function is slightly more skewed to the right than the corresponding to the Social Security. This means that, conditional on observables, is more difficult for the Social Security to distinguish between individuals than it is for the individuals themselves. For women this result is even more evident. This is an implication of the rational expectations test, because it shows that individuals have internalized Social Security award rules.

5 Empirical results

In this section we, firstly, present some descriptive evidence and, secondly, present the results of the empirical analysis by gender for two different subsamples: (a) individuals with disabilities (sample B1); and, (b) individuals without disabilities (sample B0).

[12]See Benítez-Siva et al., 2004 and 2005 for further analysis on unbiased reporting.

Figure 2: Estimated density functions by model and gender



5.1 A first look at the data

First of all, from the sample of 984 men and 552 women, 19.26% of men and 18.38% of women who receive a benefit do not deserve it using our preferred criterion #6. So, the award error is much larger for men than for women[13]. Note that the average award errors in our sample are in line to those estimated in Benitez-Silva et al (2005) or even Nagi (1969). There are several disabilities that are not present among individuals who receive but do not deserve the benefit (disability for global visual tasks, for hearing any sound, for communicating through alternative languages, not sealed gestures or reading-writing, for remembering people/objects or informations/past episodes and for executing simple or complex orders are examples). On the other hand, individuals who receive but do not deserve often have osteoarticular or musculoskeletal deficiencies in column and upper and low extremities, and disabilities for moving not heavy objects and using utensils and tools. Undoubtedly, these deficiencies are painful, but is difficult to check their severity (Pérez Rueda et al., 2000). Moreover, none of these individuals needs a caretaker for daily activities. As regards those individuals who receive and deserve, the most common disabilities are for getting up and down, moving not heavy objects, moving without way of transport, going in public transport or driving own vehicle.

[13]See Appendix C, Table C.2 for descriptive statistics.

Descriptive statistics by socioeconomic characteristics (Table C.3) reveals that there are more married men pensioners than women, and 90% of men who do not deserve are household breadwinners. Approximately half of pensioners that deserve are between 55 and 59 years old and around 30% of those who do not deserve belong to this age interval. A majority of male pensioners only have elementary education and were previously skilled workers. Also a majority of female pensioners only have elementary education but were mainly unskilled workers.

5.2 Individuals with disabilities

We have estimated a bivariate probit model for the decisions of deserving and receiving a permanent disability benefit (see Table D.1) restricting the sample to individuals with disabilities (sample B1). We assume that deserving precedes in time to receiving.

Having a disability or deficiency has a positive and significant impact on both equations. We also find a number of socioeconomic variables that have a significant impact on both probabilities: age between 55 and 59, change of house because of a disability, impairment certificate, caretaker, rehabilitation treatment, level of education, employed, unemployed and professional occupation.

Alternatively, we find some socioeconomic variables that are significant in the receiving equation and not in the deserving one: the married and main breadwinner dummies, the variables related to the economic activity of the spouse, and the region of residence are not significant in the deserving equation, and specially the regional dummies. Living in Murcia (the omitted region) seems to guarantee the highest probability of receiving a disability benefit without deserving it for both gender. The award error in Andalucia and Extremadura, for men, and only Andalucia, for women, are also very important. For the rest of the Spanish regions it is notoriously smaller.

5.2.1 Marginal effects

In Table D.2 we present the marginal effects associated to the estimated coefficients for both gender. In order to evaluate them we use the following baseline: men/women less than 55 years old, not married, college education, white collar occupation, living in Murcia, with only disabilities of moderate severity, without impairment certificate, that has not received treatment of rehabilitation nor changed of residence because of a disability and that does not need caretaker. The baseline probabilities of deserving are 0.324 for men and 0.211 for women, which are relatively high given that the reference individual only suffers disabilities of moderate severity. However, we have to take into account that although we have tried to consider the maximum number of daily living activities when elaborating the self-reported disability indicators, there are several unobserved factors such as pain or personality that cannot be controlled for. The baseline probabilities of receiving are 0.439 for men and 0.295 for women. That is, they are 35.49% and 39.81% higher than the corresponding deserving probabilities. Moreover, men have a probability of deserving and receiving higher than women (53.68% and 47.61%, respectively), but differences between deserving and receiving are about the same regardless the gender.

Disabilities, deficiencies and health variables Table 7 shows for both genders the disabilities whose marginal effects are the highest, both for deserving and receiving. The only disabilities with similar deserving and receiving probabilities are going in public transport for men and communicating for women. For men, the probability of deserving is smaller than the probability of receiving for deficiencies in upper an lower extremities (152.61%), houseworking (96.89%) and communicating (53.21%). As regards women, the same happens for executing orders (165.81%), moving inside home (61.09%) and maintaining body postures (60.02%). Disabilities for moving inside home, houseworking and maintaining body postures are related to deficiencies in the vertebral column and upper and lower extremities. In most cases they have

Table 6: Award error by age group

age group	male	inc.	female	inc.
30-34	6.89	–	6.30	—
35-39	7.75	.125	6.92	.098
40-44	9.12	.178	7.58	.095
45-49	9.33	.022	8.61	.136
50-54	15.84	.698	11.36	.319
55-59	20.35	.285	16.41	.444

Table 7: Key marginal effect of disabilities in both the probability of deserving and receiving.

	Deserve	Receive
Men	Relating to people (98.26%)	Relating to people (47.79%)
	Looking after oneself (64.11%)	Houseworking (46.71%)
	Moving inside home (56.6%)	Communicating (40.52%)
	Going in public transport (48.78%)	Going in pub. trans. (33.86%)
Women	Seeing (156.57%)	Executing orders (144.02%)
	Communicating (128.95%)	Communicating (106.46%)
	Vertebral column (121.21%)	Hearing (81.71%)
	Going in pub. trans. (111.44%).	Houseworking (54.79%)

an osteoarticular origin (arthritis, rheumatism, curvature of the spine, disc hernia) and this make diagnosis quite difficult because the aptitude for bearing pain is neither measurable nor unobservable.

Needing a caretaker for daily living activities increases the deserving probability in 92.46% for men and 40.73% for women. This variable is quite trustworthy because an individual who needs somebody to take care of him deserves and should receive a disability benefit. Whether an individual has changed of house because of a disability, produces an increase in the receiving probability of 53.03% for men and 66.73% for women. If he/she has an impairment certificate, raises these probabilities by 59.84% for men and 77.17% for women. It is important to stress that for the case of men with an impairment certificate, the probability of receiving nearly doubles the deserving one. This implies that the impairment certificate, which gives some fiscal advantages, is being used for purposes other than getting disability benefits.

Finally, for women, having completed a rehabilitation treatment increases the deserving and receiving probabilities by 8.16%, and 4.33%, respectively. The impact is significatively greater for men with corresponding figures of 14.68% and 25.57%.

The role of age Age 55–59 is another important determinant of both probabilities. The probability of deserving increases 8.28 and 30.64 for men and women, respectively. Interestingly, the probability of receiving is higher than the probability of deserving (45.02% for men and 24.69% for women). Without any doubt, these results illustrate that disability pensions have been used to ease transitions to retirement before the age benefits are first available (an issue mentioned by Boldrin et al., 1999).

In order to clearly establish that the award error is not independent of age we present in Table 6 the estimated award error by age group and gender. In order to get a better picture of the effect of age we include in this Table data for younger individuals (30–44). For individuals in

the 30-39 age range the award error is relatively low, not much higher than the standard five per cent. Then it increases mildly for individuals in the 40-44 or 45-49 age groups, and, then, more rapidly for individuals in the 50-54 and 55-59 age group. For the latter age group the average estimated award error, as reported in Table 6, is 20.35 and 16.41 percent for mean and women respectively (28.5 and 44.4 percent larger than they are for the 50-54 age group respectively).

Socioeconomic variables Being unemployed increases the probability of deserving a benefit by 52.49% for men and 31.88% for women There are several competing explanation for this evidence. For example, poor health workers may have a higher probability of becoming unemployed and experiment longer periods of unemployment than others (Stewart, 2001; Ruhm, 2000, 2003). Alternatively, the unemployed may have lower opportunity costs of applying for disability benefits than employed, that is, they would not apply for benefits while employed but will do it in the event of job loss (Autor and Duggan, 2003). However, the receiving probability when unemployed decreases by 25.18% for men and 94.78% for women. Finally, there can be reticences for awarding disability benefits to unemployed workers to avoid the phenomenon known as "hidden unemployment" (Parsons, 1980 ; Haveman and Wolfe, 1984a).

An endogeneity problem for the variable unemployed would imply that poor health is the cause rather than the consequence of losing the job. To check this we use the following question from the DDHS survey: "Have you changed your relation with economic activity due to a disability?". From the sample of 984 men (552 women), there are 85 men (70 women) unemployed, from which only 11 men (9 women) answered in the affirmative to the previous question, indicating also that they were working before health shock and just afterwards became unemployed. Thus, the fraction of respondent that changed status due to a shock is small enough to cause any serious endogeneity problem.

Clearly marital status and household breadwinner are additional policy variables for benefit concession. While marital status is not significant in the deserving equation, being married increases the receiving probability by 8.65% for men and 1.66% for women. Moreover, if the individual is the head of the household, the receiving probabilities increase 7.53% for men and 18.86% for women.

Concerning variables representing the spouse's labor force status[14], we find that having a working spouse reduces the probability of receiving a benefit by 29 and 14 % for men and women, respectively. Moreover, if the spouse receives a disability benefit, the probability that the individual also receives a benefits increases by 22.47% for men and 35.46% for women. Both findings provide evidence of complementarities in leisure.

The probability of deserving increases 93.01% for men (61.23% for women) when moving from college education and white collar occupation to elementary education and unskilled job. It also increases 49.55% for men (39.43% for women) when moving to high school level and skilled job. The deserving probability increases more when moving from college-white collar to high school-white collar (49.36%) than when moving to college-skilled (12.95%), for men. For women, we can observe that the opposite is true, although differences are smaller(17.10% in the first case and 21.37% in the second one).

The receiving probability achieves its maximum when the individual has elementary education and an unskilled job, and it decreases as the level of education and/or the quality of occupation increases. In this sense, Autor and Duggan (2003) account for the role of disability benefits in inducing labor force exit among the low-skilled workers. For both genders, the probability of receiving increases more with the educational level than with occupation. Moreover,

[14]Several studies, for example Peracchi and Welch (1994), Blau and Riphahn (1999) or Jiménez et al. (1999) have observed that the spouse's labor force status affects retirement behavior of the other member of the couple. In this paper we have proxied the spouse's labor status using two dummy variables indicating whether he/she is working or receiving a permanent disability benefit.

Table 8: Manual disabilities and skill level

	Men (N=984)			Women (N=552)		
	White collar	Skilled	Unskilled	White collar	Skilled	Unskilled
Moving not heavy objects	16.32	34.21	49.47	14.81	17.28	67.90
Using tools	11.39	33.66	54.95	13.51	14.86	71.62
Manipulating small objects	14.60	32.12	53.28	15.32	12.61	72.07

it seems to have a relationship with the manual character of the jobs.[15] Table 8, which cross-tabulates the prevalence of hands and fingers disabilities with skill by gender, strongly supports this argument, since these disabilities are very concentrated in unskilled (female) workers.

Undoubtedly the region of residence hides additional policy tools for benefit concession since individuals in the (by 1999) low-income and high-fraction of agricultural workers regions of Murcia, Andalucia and Extremadura, have significantly higher probabilities of receiving benefits than individuals in any other region, thereby implying larger award errors.

5.3 Individuals without disabilities

In this section we study the probability of receiving a benefit conditional on being healthy (see Table D.3), that is the probability of receiving a benefits solely on economic grounds. The analysis is conducted in the sample of individuals without disabilities (16980 men and 7461 women, sample B0). We specify the conditional probability model as a Probit, and the set of explanatory variables includes controls for education, place of residence, marital status, main household breadwinner and age group. We are not able to capture differences related to the activity sector or professional situation since they are not available for non-working pensioners. Once we have estimated the model, we compute the marginal effects with respect to a baseline individual with the following characteristics: single, no breadwinner, high school education and living in Asturias or Cantabria. The results of this exercise are reported in Table D.4.

The probability of receiving a benefit being healthy sharply increases with the age group (the probability of receiving a benefit for those aged 55–59 practically doubles that of those aged 45–49), and decreases with the level of education and for those that are main breadwinner for both gender. By region, the probability of receiving a benefit conditional on being healthy is much higher in Asturias-Cantabria (specially for men), Murcia (specially for women) Andalusia and, to a lesser extend, in Extremadura than in any other region. This confirms that policymakers allow some healthy individuals to get (disability) benefits without any penalties and, more importantly, without any disability, before the early retirement age, specially in poorer (see Table C.1) Northern regions (such as Asturias-Cantabria) and Southern regions such as Andalucia and Extremadura. Thus, as in many other EU countries, disability benefits have been used with redistributive purposes, in order to increase per capita income is some depressed regions.

6 An alternative mechanism for awarding disability benefits

In this section we propose a simple screening alternative to the Social Security awarding process[16]. We evaluate the relative efficiency, evaluated by the award error, by both methods of classification. The best mechanism will be that providing the minimum number of undeserved disability

[15] For example: assembly lines, seamstresses in court and confection workshops, workmen of toys factories, replacers of supermarkets. In all these occupations, there are many unskilled workers that become unable for doing their jobs if they suffer any kind of manual disability.

[16] See Benítez Silva et al. (2005) for an alternative screening mechanism.

benefits.

If the Social Security were to know the true disability status of the applicants, d^*, it would use this information in the awarding process. We have mentioned that some individuals have incentives to misreport to Social Security, but these incentives may be absent when answering a confidential survey. Under the hypothesis of rational expectations we can establish a two-stage process: first we can regress our preferred deserving indicator (based on self-reported measures) on a set of explanatory variables X.[17] After estimation, we compute the probability of deserving conditional on X, $\hat{P}(d|X)$. Second, we award (A) a benefit to those individuals having a probability of deserving above a given threshold, $\alpha \in [0, 1]$:

$$A = I\{\hat{P}(d|X) \geq \alpha\} \tag{1}$$

Adjusting the level of α we obtain different percentages of benefits (ie. the higher α, the smaller the number of disability benefits awarded).

Consider that the Social Security administration objective is to achieve a given fraction of disability pensions, say p. Then α would be given by the minimum of the following expression:

$$\underset{\alpha}{Min}\ p = \int I\{\hat{P}(d|X) \geq \alpha\} f(X) dX \tag{2}$$

We can compute the sample analog of expression (2) and we obtain the optimal value of α, say $\hat{\alpha}$, for which the percentage of individuals which receive benefits is equal to the Social security objective, p.

Figure 3 shows the corresponding observed density function for both men and women. We indicate with a discontinuous line the index (α) that makes the right tail equal to the probability of receiving a disability benefit conditioned to deserving it[18]. This probability is 0.4919 for men and 0.1610 for women, and the corresponding indexes are 0.3647 for men and 1.2455 for women, with a standard deviation equal to 0.0016 and 0.0034, respectively.

We award a disability benefit to those individuals with a value of $\hat{P}(d|X)$ greater than $\hat{\alpha}$. Then we compare the efficiency between the Social Security and the screening mechanism. Our mechanism will do better than Social Security if it satisfies three requirements: firstly, it reduces the number of individuals that receive with Social Security but don't deserve; secondly, it includes all individuals that are receiving according to Social Security and deserve; and finally, it does not award benefits to individuals who do not deserve it.

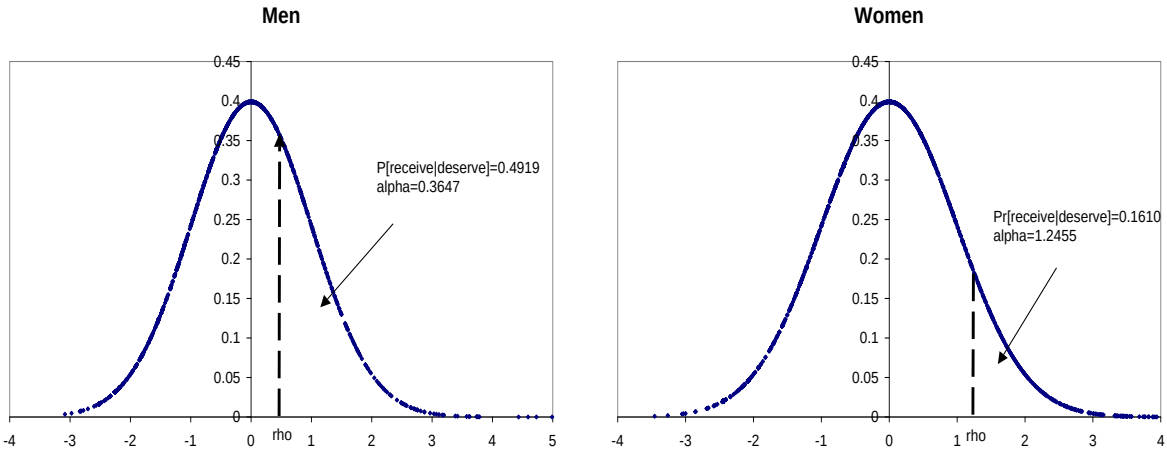
6.1 Results

Table 9 presents some summary measures obtained from the analysis. First, we observe that in either sample (B or B1) all individuals who receive and deserve benefits with Social Security also receive with the alternative mechanism. Second, in sample B the number of individuals who receive but do not deserve decreases from 63.5% to 4.39% for men and from 49.2% to 5.1% for women. However, these number include the reduction induced by those without any

[17] In the probit model the dependent variable is the preferred criterion # 6. The set of explanatory variables includes: rehabilitation treatment, caretaker, impairment certificate, change of house because of a disability and the 36 disabilities mentioned in Appendix C.1. With respect to disabilities we have defined a dummy variable that takes the value one if disability is suffered with moderate or higher severity and with a prognosis different from recoverable. The size of the sample is bigger than in the bivariate probit model because we do not need to drop observations for which some economic variables are unknown. That's why we can estimate all disabilities separately. The results of the estimation procedure are available on request.

[18] We could have used the rate of awards (# of applications / # of awards), but with the information from the survey we only know if the individual receives a benefit but not if he has applied for and it has been denied. The economic interpretation for using the probability of receiving conditioned to deserving is that individuals with a high probability of deserving should receive a benefit.

Figure 3: Estimated probabilities of deserving a benefit. Probit estimates



disability. If we restrict ourselves to those with some disability the reduction is less important but still of a considerable amount: from 23.7% to 4.4 % and 12.1% to 5.1 % for men and women, respectively. Figures for sample B1 (the estimation sample) are more impressive: the reduction of the award error goes from 19.3 % to 0.6 % and from 11.2 % to 2.3 % for men and women, respectively. Third, this mechanism does not assign benefits to any individual who does not receive nor deserve benefits. Finally, in sample B we detect 2.49 % of men and 3.76 % of women who deserve but do not receive according to Social Security (1.9 % and 3.39 %, respectively, in sample B1). Unfortunately we do not know whether they have not applied for benefits or, conditional on applying, their applications have been rejected.

From those individuals who receive but do not deserve and declare to suffer some disabilities, 82% declare to suffer disabilities for moving without way of transport, in public transport or in his own vehicle. However, only 21.42% of them receive technical aid. This suggests that the improvement of the facilities and the elimination of architectural barriers could help in avoiding some of these award errors.

The main lesson of this section is that administrative data should be regarded with some suspicion. This is so because applicants have incentives to misreport true disability status, but also because Provincial Departments of Social Security may have quantitative (or redistributive) targets regarding the placement of individuals.

We do not propose the disappearance of the whole bureaucracy of the Social Security, just because individuals could be tempted to misreport disabilities when answering the survey with the purpose of increasing the probability of deserving a benefit. In order to avoid these problems and increase the efficiency of the system (by eliminating the redistributive component), we suggest several control measures on both the applicant and the evaluation teams. For example, a medical team should visit the home and the working place of the applicant and study the way of displacement between both. Also random audits should be performed on medical judgements, conditioning examiner's wage earnings to the coincidence between his verdict and that of the auditor.

7 Conclusions

In this paper we audit the permanent disability awarding process in Spain in order to identify award errors, which can be assimilated in many cases (specially for those that are healthy), to benefit concessions due to economic reasons. In a preliminary but not less important step, we

Table 9: Comparison between the Social Security and the screening mechanism.

	Sample B		Sample B1	
	Men	Women	Men	Women
Sample size	18235	8142	984	552
Social Security awarding process				
* Receive	1333	429	379	136
+ Deserve	487	218	306	125
+ Do not deserve	846	211	73	11
(without disabilities)	*695*	*181*		
(with disabilities)	*151*	*30*		
* Do not receive	16902	713	605	416
Screening mechanism				
* Should be granted	523	239	314	132
+ receive with SS and deserve	487	218	306	111
+ receive with SS and not deserve	23	12	2	3
+ not receive with SS and deserve	13	9	6	4
+ not receive with SS and not deserve	0	0	0	0
* Should not be granted	18900	20235	670	420
Summary of errors (%)				
* Total SS award error	63.5	49.2	19.3	8.1
(Award error without disabilities)	*100.0*	*100.0*		
(Award error with disabilities)	*23.7*	*12.1*	*19.3*	*8.1*
* Total Screening mechanism error	6.88	8.78	2.54	5.93
Award error	*4.39*	*5.02*	*0.64*	*2.27*
Rejection error	*2.49*	*3.76*	*1.90*	*3.03*

Sample B includes all the available observations.
Sample B1 is restricted to individual with disabilities.

have designed up to six alternative deserving indicators using a very large number of self-reported disability measures from the DDHS survey. After choosing the best indicator on the basis of exogeneity and consistency criteria, we have estimated a bivariate latent variable econometric model for the decisions of receiving and deserving for those individuals who have developed contributive careers, as well as a probability model for the probability of receiving a benefit conditional on not having any disability.

The total estimated award error is extremely high: 63.5 % for men and 49.2 % for women. However, 82.1 and 85.6 % of the total error is due to awards to individuals without disabilities, that is, awards due to economic reasons. The remaining fraction of award errors is either due to classification errors, to economic reasons, or, to a combination of both factors. If we extrapolate these figures to the total number of disability benefits in Spain in 2000 (source: Anuario de Estadisticas Laborales 2000) for individuals aged 45–59 we find that 187,047 DI pensions (146,047 for men and 46,969 for women) are due solely to economic reasons. The implicit cost of this benefits is 1450 millions of euros or 0.2 % of the Spanish GDP in year 2000. The remaining 38,734 are likely to be classification errors alone or in combination with some economic reasons.

We have also learned about the way award errors vary with socioeconomic characteristics and regional policies. After controlling for disabilities, limitations and other factors, we find that males, individuals aged 55–59, self-employed or workers in the agricultural sector have a probability of receiving a benefit without deserving it significantly higher than the rest of individuals. This confirms that disability benefits have been used as a pathway to retirement for individuals below the early retirement age, specially for men.

We have also shown that there are significant regional differences in the probability of receiving a benefit. This probability is higher in less developed (by 1999) Spanish regions: Asturias-

Cantabria, Murcia, Andalucia and Extremadura. If we take into account that the award process depends on Social Security Provincial offices, it becomes clear that the evaluation of the worker health status does not only depend solely on medical grounds. The head of each Social Security Provincial Office determines if a given applicant gets a disability pension on the basis of the statement proposed by the Disability Evaluation Team. This statement indicates if there is a decrease or annulment of work capacity, if the above mentioned situation is constitutive of disability and in what degree. Therefore, the existence of an award error implies either that the medical reports provided by the applicant were untrue, or that the classification statement elaborated by the evaluation team is incorrect, or, most likely, that many disabilities in these regions are due to economic reasons.

It is also important to note that the probability of getting a benefit being healthy or disability because of economic reasons is not distributed at random across the population. We have shown that it increases with age and decreases with the level of education. It is also important to stress the large variation by region on the basis of economic grounds: the probability of getting benefits being healthy is much larger in depressed regions than in other regions.

There are several policies that may help in reducing award errors. One possibility would be to carry out more diagnosis tests and explorations, although this would increase audit expenditures. For example, in the case of the osteoarticular pathologies in which pain plays a crucial role there is a trade off between the accomplishment of some expensive tests and the risk of paying undue pensions. We cannot forget the figure of revision due to improvement, worsening or misdiagnosis before 65 years old. This instrument eliminates the possibility of a life declaration without possibility of repeal. Nevertheless, it does not seem that revisions done up to the moment have settled the problem of award errors, since in the DDHS survey there are 2448 pensioners older than 65 years old, from which 1164 (47.55 %) have declared not to suffer any disability.

Finally, we have designed a screening mechanism in which individuals receive a benefit if they have a sufficiently high deserving probability. With this mechanism the award error is significantly reduced. We do not propose to replace the Social Security awarding process by a computerized procedure, but emphasize that efficiency can be improved and expenditures in non-deserved benefits may be substantially reduced.

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Appendix

A. Disabilities, Deficiencies and Health Status Survey

In 1986, the National Institute of Statistics (INE) performed a survey to detect the most important disabilities and deficiencies among the Spanish population according to the International Classification of Disabilities, Deficiencies and Impairments of the World Health Organization (WHO). This information has turned obsolete and it has been necessary to renew it. The Disabilities, Deficiencies and Health Status Survey [www.ine.es/prodyser/pubweb/discapa/discapamenu.htm] was aimed at identifying the actual situation of individuals with disabilities and was carried out by the Spanish statistical office during the second term of 1999. The main method to collect the information is personal interview to all the members of the selected household.

The survey is divided in three phases identified with the following questionnaires:

1. Household Questionnaire: collects socioeconomic information from all household members in order to establish differences between people with and without disabilities.

2. Disabilities and Deficiencies Questionnaire: for people of 6 and more years who suffer at least one disability or deficiency. Individuals are required to enumerate all disabilities suffered according to a established classification of 36 disabilities and 27 deficiencies, indicating also the degree of severity, expected evolution, age when suffering the disability problem, deficiency that caused the disability, origin and duration. Finally, it also includes questions relating disabilities to changes in occupation and labor force status.

   The D&D questionnaire has two important limitations: the degree of disability for permanent disability pensioners, and the possible denial of an application for disability benefits are unknown. The former limitation prevent us from analyzing the rejection error.

3. Limitations and Impairments Questionnaire: for children with less than 6 years that suffer some limitation (not used for the purpose of the paper)

4. Health Questionnaire: selects randomly one member from each household no matter if he is affected or not by some disability (not used in the paper because the random nature of the sample reduces the number of available observations considerably)

This survey only gathers those disabilities that have affected or are expected to affect daily living activities for a period over a year. It is necessary to specify that certain disabilities produced by certain disfunctions (schizophrenia, depression, labyrinthine dizziness...) appear

repeatedly in certain moments called crisis during life. An individual is considered to suffer one of these disabilities if the sum of the critical periods is larger than one year.

All disabilities are investigated even if they are overcome with the use of some technical help. It is important to specify that only are considered to be disabilities those that have been overcome with the use of technical external helps (crutches, wheels chair, prothesis of substitution of some member, auditory devices, probes, oxygen...), remaining excluded those that have been overcome by the use of technical internal helps (pacemaker, intraocular lenses, prothesis of knee, cardiac valves, cerebral valves of decompression...). An exception is done in case of vision disabilities, since we only take into account those that survive with the use of glasses or contact lenses.

For the definition of the six disability indicators, we have not included any reference to the use of technical help, because legislation establishes that each case must be studied separately, according to impairment, nature of the help and adaptation degree to it.

B. Description of the variables

Classification of disabilities, severity and prognosis

For each of the following 36 disabilities we define a binary variable that takes the value one if the individual declares to suffer this disability and the value zero in other case.

1. Seeing: (a)Receiving any image; (b) Global visual tasks; (c) Detailed visual tasks; (d) Other visual disabilities.
2. Hearing (a): Hearing any sound; (b) Hearing strong sounds; (c) Listening the speech.
3. Communicating: (a) Communicating through speech; (b) Communicating through alternative languages; (c) Communicating through not sealed gestures; (d) Communicating through conventional writing - reading.
4. Learning, applying knowledge and developing topics: (a) Recognizing persons/objects and being orientated in space and in time; (b) Remembering information and recent or past episodes; (c) Dealing and executing simple orders and/or doing simple tasks; (d) Dealing and executing complex orders and/or doing complex tasks.
5. Moving: (a) Changes and maintenance of body positions; (b) Getting up and down and standing up; (c) Moving inside home.
6. Using arms and hands: (a) Moving/transporting not very heavy objects; (b) Using utensils and tools; (c) Manipulating small objects with hands and fingers.
7. Moving out of home: (a) Moving without way of transport; (b) Moving in public transport; (c) Driving own vehicle.
8. Looking after oneself: (a) Washing oneself; (b) Controlling physical needs; (c) Dressing and undressing; (d) Eating and drinking;
9. Houseworking: (a) Do the shopping; (b) Cooking; (c) Washing and ironing clothes; (d) Cleaning the house; (e) Looking after the well-being of the family.
10. Relating to people: (a) Supporting relations of fondness with close relatives; (b) Doing friends; (c) Relating to companions, chiefs and subordinates;

Classification of the variable severity
1. Without any difficulty
2. With moderate difficulty
3. With serious difficulty
4. Can not do the activity

Classification of variable prognosis
1. Recoverable
2. Recoverable with restrictions
3. Stable without perspectives of improvement
4. Can go worse
5. It is not possible to determine it.

Classification of the deficiencies

We group the following 27 deficiencies in 8 categories:

1. Mental deficiencies: (a) Insanity; (b) Other mental illnesses.
2. Visual deficiencies: (a) Total blindness; (b) Bad vision.
3. Hearing deficiencies: (a) Deafness before speaking; (b) Deafness after speaking; (c) Bad hearing; (d) Disfunction of the balance.
4. Deficiencies of the language, speech and voice: (a) Muteness (not because of deafness); (b) Difficult or incomprehensible speech.
5. Osteoarticular deficiencies: (a) Head; (b) Vertebral column; (c) Upper extremities; (d) Low extremities.
6. Deficiencies of the nervous system: (a) Paralysis of an upper extremity; (b) Paralysis of a low extremity; (c) Paraplegia; (d) Tetraplegia; (e) Dysfunction of the coordination of movements; (f) Other deficiencies of the nervous system.
7. Visceral deficiencies: (a) Respiratory device; (b) Cardiovascular device; (c) Digestive device; (d) Genital-urinary device; (e) Endocrine-metabolic device; (f) Hematopoietic device and immunitary system.
8. Other deficiencies: (a) Skin.

Classification of the problem that caused the deficiency

1. Congenital
2. Problems in the childbirth
3. Traffic accident
4. Domestic accident
5. Leisure accident
6. Labor accident
7. Another type of accident
8. Common disease
9. Occupational disease
10. Other reasons

Description of the variables of the bivariate probit model

* **Disabilities and deficiencies:**

We have defined a binary variable that takes the value one if the individual suffers one of the following disabilities or deficiencies.:

- Deficiencies: (1) Vertebral column; (2) Upper and low extremities.
- Disabilities: (1) Seeing; (2) Hearing; (3) Communicating; (4) Remembering; (5) Executing orders; (6) Maintaining body postures; (7) Moving inside home; (8) Using hands and fingers; (9) Moving outside home; (10) Taking care of oneself; (11) Houseworking; (12) Relating.

We have only included deficiencies referred to vertebral column and upper and low extremities because given the definitions of the survey, a deficiency is the pathological cause of a disability, it seems reasonable that an individual with disability for global visual tasks is also going to declare bad vision, or an individual with paralysis of a low extremity is going to answer disability for moving inside home and using public transport. Hence, to avoid unnecessary duplicities we have omitted most of the deficiencies in the bivariate probit model. Besides that, what really matters for permanent disability is not the name of the illness but the repercussion on labor capacity.

In fact, osteoarticular deficiencies are the most important ones. In fact, 56.03% of individuals receiving a benefit (22.43% men and 33.60% women) suffer vertebral column problems, 29.46% (12.66% men and 16.80% women) are affected by upper extremities deficiencies and 37.69% (16.89% men and 20.80%) by low extremities pathologies. This deficiencies are also declared by many individuals who receive a benefit but do not deserve it. (See Tables C.2 and C.3).

Socioeconomic variables	
Age between 55-59	1 if age is between 55 and 59
Married	1 if he/she is married
Spouse working	1 if spouse is working
Spouse disability benefit	1 if spouse receives a disability benefit
Household main breadwinner	1 if he/she is the household main breadwinner
Health variables	
Caretaker	1 if he/she needs somebody to take care of him/her
Impairment certificate	1 if he/has has received an impairment certificate
Rehabilitation treatment	1 if he/she has finished a rehabilitation treatment
Change of house	1 if he/she has moved because of a disability
Level of Education	
Without studies	(omitted category)
Elementary	1 if he/she has only finished elementary education
High School	1 if he/she has only finished high school or vocational training
College	1 if he/she is a graduate or bachelor
Relation with economic activity	
employed	1 if he/she is employed (working or unemployed)
Unemployed	1 if he/she is unemployed but has already worked
Skill level:	
Unskilled	(Omitted category)
White collar	1 if management, public administration, white collars workers, and intellectuals
Skilled	1 if he/she is a qualified worker in agriculture, cattle raising, fishing, industry, mining industry, construction, services
Occupation:	
family helper	(Omitted category)
Self-employer	1 if he/she is a self-employer
Public sector	1 if he/she is working at the public sector
Private sector	1 if he/she is working at the private sector

* **Sector**: we have defined a binary variable for each sector (primary industries, industry, construction and services).

* **Place of residence**: we have defined a binary variable for each of the 19 Spanish regions (see Table C.1 for a list of Spanish regions). However, due to the small sample size for some communities we have grouped Ceuta and Melilla with Andalucía, Navarra and Rioja with Aragón and Asturias with Cantabria.

C. Descriptive Tables

Table C.1. Ratio permanent disability benefits to retirement benefits

	Ratio disability to retirement benefits								GDPpc
	1985	1988	1991	1994	1997	1998	2000	2002	1998
Andalucía	91.9	93.3	88.6	84.6	76.5	27.3	27.0	26.4	56.1
Aragón	42.1	40.7	38.6	38.0	34.0	13.6	13.2	13.1	89.0
Asturias	56.4	54.3	51.6	50.6	45.7	18.7	18.5	18.9	66.9
Baleares	42.3	41.8	42.8	45.0	43.4	19.2	20.0	20.6	118.7
Canarias	74.6	74.6	73.2	67.0	58.5	23.8	22.3	21.7	78.6
Cantabria	43.9	43.9	43.7	43.0	39.3	15.2	15.0	15.1	74.2
Castilla La M	52.9	51.9	48.7	45.8	40.3	14.2	14.1	14.3	64.5
Castilla León	54.2	52.4	48.3	45.5	39.1	13.4	12.5	11.9	73.6
Cataluña	57.2	56.8	53.5	49.2	43.4	18.7	17.9	17.1	101.4
Extremadura	56.6	57.5	55.8	53.4	47.7	18.1	16.9	16.4	55.4
Galicia	55.2	55.6	54.3	51.9	45.1	14.2	13.7	13.4	67.9
Madrid	40.2	35.4	37.5	35.6	31.0	14.2	13.2	12.6	109.2
Murcia	150.4	155.8	152.0	142.3	116.4	29.8	26.9	25.2	66.3
Navarra	52.1	49.7	46.4	44.3	39.4	16.6	16.0	15.9	98.5
País Vasco	47.8	45.3	43.1	41.0	37.0	17.6	16.6	15.8	90.3
La Rioja	65.9	64.4	60.4	58.5	50.2	18.0	17.0	16.1	96.2
Comunidad Val.	52.7	49.9	45.7	42.2	38.9	16.7	16.5	16.7	82.8
Ceuta	83.3	70.0	63.6	50.0	44.8	19.4	19.4	18.1	61.7
Melilla	100.0	94.1	88.9	90.0	90.5	33.3	33.3	32.3	64.7
España	59.1	57.5	55.2	52.2	46.4	18.3	17.6	17.2	81.5

Notes: GDPpc: Gross GDP per capita (EU15=100); Since 1998 (Law 24/1997) disability benefits for individuals aged 65+ are counted as retirement benefits. From 1998, all disability pensions from individuals 65 years old and above are converted to retirement pensions. Source: Ministry of Labor and Social Issues and FBBVA.

Table C.2. Prevalence of Disabilities and deficiencies.

	Men		Women		Men w benefits		Women w benefits	
	Deserve	Not Des	Deserve	Not Des	Deserve	Not Des	Deserve	Not Des
N	709	275	440	112	306	73	111	25
Disability for:								
Seeing	22.43	22.55	22.95	14.29	20.92	15.07	24.32	21.43
Hearing	22.99	28.00	18.86	30.36	11.44	10.96	9.01	0
Communicating	12.41	3.64	8.64	2.68	14.71	6.85	9.91	7.14
Learning, applying knowledge	10.58	0.73	9.32	1.79	12.42	0	9.91	0
Moving	32.44	18.91	41.82	25.00	40.52	30.14	45.95	14.29
Using arms and hands	33.99	23.18	43.64	28.57	46.41	36.99	48.65	42.86
Moving outside home	55.15	28.00	54.32	22.32	69.28	41.10	61.26	21.43
Looking after oneself	15.66	4.00	15.23	4.46	20.92	8.22	22.52	0
Houseworking	20.31	7.64	44.32	20.54	29.41	19.18	56.76	28.57
Relating to people	10.30	1.82	11.36	4.46	12.41	2.74	13.51	7.14
Deficiency for:								
Mental deficiencies	9.45	1.45	9.77	7.14	14.38	2.74	13.51	21.43
Visual deficiencies	20.31	21.09	20.91	13.39	18.30	9.59	21.62	14.29
Hearing deficiencies	22.28	27.64	18.18	29.46	10.78	10.96	9.01	0
Deficiencies of the language	2.40	1.09	1.59	0.89	2.94	1.37	1.80	7.14
Osteoarticular deficiencies	39.49	36.36	54.55	32.12	44.44	53.42	63.06	28.57
Deficiencies nervous system	10.58	3.64	9.77	5.36	16.67	5.48	11.71	7.14
Visceral deficiencies	11.99	8.36	8.41	8.93	19.93	15.07	9.01	21.43
Other deficiencies	0.14	0.36	0.45	0	0.33	0	0.9	0

Table C.3. Socioeconomic characteristics

	Men		Women	
	Receive Deserve	Receive Not deserve	Receive Deserve	Receive Not deserve
Needs caretaker	7.30	0	18.11	0
Rehabilitation treatment	30.25	28.38	35.43	35.29
Change of house because of disability	7.62	6.76	10.24	11.76
Married	80.72	83.56	64.86	50
Spouse is working	15.14	6.71	29.53	9.06
Spouse receives DB	3.20	5.03	7.67	19.19
Main breadwinner	84.97	90.41	27.03	35.71
Age between 55-59	47.06	35.62	47.75	28.57
Education				
*Without elementary	31.05	32.77	35.13	28.57
*Elementary	46.73	43.94	40.54	35.71
*High School	18.63	20.55	15.32	21.43
*College	3.59	2.74	9.01	14.29
Professional occupation (before DB)				
*Unskilled	22.14	18.84	52.25	42.87
*Skilled	65.44	72.46	40.54	35.71
*White collar	12.42	8.70	7.21	21.42

D. Estimates and marginals effects

Table D.1. Bivariate probit. Sample with disabilities (sample B1)

	Men				Women			
	Deserve		Receive		Deserve		Receive	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t
Constant	-0.4046	-3.25	-0.8471	-2.95	-0.8304	-2.46	-0.8887	-2.89
Disability								
Vertebral column	0.4186	2.14	0.3044	2.02	0.7184	3.48	0.1936	2.08
Upper and low extremities	0.0552	2.27	0.2642	2.50	0.4462	1.18	0.0813	2.39
Seeing	0.3658	2.27	0.0253	2.17	0.9053	4.01	0.0346	2.20
Hearing	0.3194	1.93	0.3654	3.54	0.4573	2.13	0.6298	2.84
Communicating	0.2465	2.00	0.4685	2.01	0.7546	2.75	0.8165	2.45
Remembering	0.2852	2.37	0.3812	2.95	0.3467	2.59	0.2913	2.59
Executing orders	0.3134	1.90	0.2885	2.80	0.1950	2.19	1.1224	1.93
Maintaining body postures	0.2282	2.05	0.0316	2.16	0.0706	3.33	0.2068	1.99
Moving inside home	0.4744	2.41	0.0295	2.17	0.0291	3.13	0.1602	2.80
Using hands and fingers	0.2162	2.49	0.2821	2.19	0.3649	2.14	0.1926	2.24
Moving outside home	0.4109	2.87	0.3889	3.63	0.6666	3.72	0.1091	2.65
Taking care of oneself	0.5355	2.19	0.1974	3.10	0.0938	2.31	0.1865	2.36
Houseworking	0.0405	2.18	0.5447	2.95	0.3401	1.83	0.4302	2.48
Relating	0.8202	2.38	0.5579	2.93	0.5060	2.30	0.1732	3.05
Socioeconomic characteristics								
Age between 55-59	0.0733	2.64	0.1379	2.21	0.2069	2.35	0.1332	2.90
Change of house	0.3917	2.11	0.2647	2.18	0.0516	2.15	0.5162	1.91
Impairment certificate	0.1240	2.91	0.7150	5.77	0.2575	2.41	0.5965	3.76
Needs caretaker	0.7702	2.38	0.1811	2.60	0.2694	2.93	0.3602	2.20
Rehabilitation treatment	0.1286	2.81	0.2731	1.92	0.0582	2.34	0.0366	2.24
Spouse working	0.0191	1.52	-0.4148	-2.82	0.0038	1.18	-0.1079	-2.13
Spouse disability benefit	0.0189	1.75	0.3089	2.67	0.0058	1.69	0.1699	2.55
Married	0.0249	0.63	0.0988	2.01	0.0105	0.71	0.0141	1.98
Elementary	0.8045	2.09	1.6779	1.96	0.3394	2.63	0.9641	2.51
High School	0.5977	2.23	0.6317	2.05	0.0300	2.39	-0.1359	-2.88
College	0.2952	2.05	0.3559	2.42	-0.0893	-2.27	-0.6535	-2.02
Working	-0.0743	-2.23	0.2058	2.17	-0.0768	-2.04	0.1614	2.51
Unemployed	0.2556	2.76	-0.0917	-2.21	0.0810	2.19	-1.2573	-2.87
Main breadwinner	-0.1978	-0.96	0.0860	2.43	0.0243	1.11	0.1554	2.67
White collar	-0.1316	-2.60	0.1696	3.43	0.1917	2.27	0.8429	3.42
Skilled worker	-0.0175	3.34	0.1779	1.53	0.3394	1.94	0.9641	4.00
Regions (Murcia omitted)								
Andalucia-Ceuta-Melilla	0.7624	1.39	-0.0073	-2.09	0.5326	1.17	-0.1275	-2.08
Aragón-Cantabria-Rioja	0.7546	1.60	-0.2636	-1.99	0.5235	1.21	-0.4570	-1.89
Asturias-Cantabria	1.0826	1.18	-1.0627	-2.22	0.2898	0.76	-0.5114	-2.46
Baleares	0.7349	1.12	-1.0076	-2.02	0.2621	0.61	-0.1546	-2.54
Canarias	0.4906	0.96	-1.0566	-1.91	0.5562	1.32	-0.6078	-2.31
Castilla La Mancha	0.9363	0.86	-0.9415	-3.19	0.2946	0.80	-0.3446	-1.97
Castilla León	0.5839	1.35	-0.8752	-2.04	0.3379	1.16	-0.5008	-1.84
Cataluña	0.6279	1.41	-0.2638	-2.29	0.5208	1.13	-0.4553	-2.06
Extremadura	1.1119	1.01	-0.0242	-1.90	0.8071	1.38	-0.2529	-1.87
Galicia	0.4978	1.13	-0.3957	-1.99	0.2577	0.49	-0.4569	-2.26
Madrid	1.0609	1.06	-0.9277	-2.08	0.4127	1.18	-0.6261	-2.78
País Vasco	0.0582	1.24	-0.8396	-2.87	0.0953	0.23	-0.7922	-2.46
Comunidad Valenciana	0.5363	0.75	-0.5315	-1.84	0.3380	1.11	-0.4381	-2.54
N				984				552
Rho				0.3712				0.3194
Log Likelihood				-701.8973				-462.5137

Table D.2. Marginal probabilities.

	Men				Women			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Baseline(BL)	0.329		0.462		0.214		0.302	
Disability								
Vertebral column	0.484	46.85	0.574	24.41	0.467	117.60	0.365	20.53
Upper and low extremities	0.343	4.21	0.558	20.97	0.359	67.50	0.323	6.89
Seeing	0.463	40.48	0.463	0.41	0.542	152.66	0.307	1.41
Hearing	0.444	34.90	0.598	29.55	0.364	69.43	0.536	77.02
Communicating	0.416	26.23	0.637	38.05	0.482	124.38	0.609	101.16
Remembering	0.431	30.81	0.605	31.12	0.322	49.84	0.390	29.02
Executing orders	0.442	34.20	0.568	23.05	0.271	26.10	0.720	137.74
Maintaining body postures	0.409	24.08	0.466	0.95	0.231	7.68	0.370	22.17
Moving inside home	0.506	53.61	0.465	0.78	0.219	1.89	0.352	16.41
Using hands and fingers	0.404	22.65	0.566	22.51	0.330	53.56	0.364	20.41
Moving outside home	0.481	45.94	0.607	31.51	0.446	107.94	0.333	10.21
Taking care of oneself	0.530	60.98	0.532	15.26	0.238	11.00	0.362	19.65
Houseworking	0.338	2.55	0.665	44.13	0.321	49.41	0.456	50.79
Relating	0.641	94.48	0.670	45.19	0.382	78.15	0.357	18.01
Socioeconomic characteristics								
Age between 55-59	0.350	8.28	0.508	12.09	0.280	30.35	0.351	15.88
Change of house	0.473	46.40	0.694	53.03	0.231	7.80	0.500	65.12
Impairment certificate	0.369	14.12	0.725	59.84	0.297	38.39	0.532	75.65
Needs caretaker	0.622	92.46	0.525	15.82	0.301	40.31	0.438	44.66
Rehabilitation treatment	0.371	14.68	0.551	25.57	0.232	8.11	0.315	4.29
Spouse working	0.325	0.65	0.332	-28.87	0.219	1.97	0.346	14.51
Spouse disability benefit	0.339	4.91	0.614	35.46	0.219	2.25	0.370	22.16
Married	0.332	2.79	0.493	8.65	0.218	1.45	0.307	1.66
Elementary and unskilled	0.624	93.01	0.882	94.51	0.089	-58.20	0.398	31.60
High School and skilled	0.483	49.55	0.795	75.24	0.094	-55.89	0.347	14.64
High School and white collar	0.483	49.36	0.784	72.92	0.072	-66.40	0.303	0.24
College and skilled	0.365	12.95	0.695	53.29	0.076	-64.54	0.181	-4.14
Main breadwinner	0.256	-20.86	0.488	7.53	0.222	3.35	0.359	18.61
Unemployed	0.493	52.49	0.339	-25.18	0.263	22.77	0.026	-91.24
AutonomousCommunities								
Andalucía-Ceuta-Melilla	0.619	91.56	0.450	-0.66	0.398	85.51	0.260	-14.06
Aragón-Navarra-Rioja	0.616	96.63	0.352	-24.43	0.395	83.88	0.165	-45.42
Asturias-Cantabria	0.733	126.86	0.119	-73.72	0.308	43.64	0.152	-49.76
Baleares	0.609	88.28	0.130	-71.23	0.299	32.13	0.251	-17.03
Canarias	0.552	70.88	0.120	-73.45	0.407	89.76	0.130	-56.89
Castilla La Mancha	0.683	111.37	0.145	-68.01	0.310	44.43	0.194	-35.69
Castilla Léon	0.550	70.07	0.160	-64.57	0.325	51.61	0.154	-48.94
Cataluña	0.567	66.15	0.352	-22.43	0.394	83.40	0.165	-45.28
Extremadura	0.743	129.79	0.444	-2.11	0.507	135.95	0.221	-27.03
Galicia	0.516	59.50	0.304	-32.94	0.297	38.42	0.165	-45.41
Madrid	0.726	124.64	0.148	-67.33	0.353	64.35	0.126	-58.16
País Vasco	0.549	69.79	0.169	-62.61	0.243	13.45	0.095	-68.49
Comunidad Valenciana	0.459	42.04	0.258	-43.03	0.326	51.73	0.170	-43.85

keys. (1): marginal probability of deserving; (3): marginal probability of receiving; (2) and (4): porcentual variation with respect to baseline

BL: man younger than 55 years old, single, college, white collar, living in Murcia, suffering only moderate severe disabilities, without rehabilitation treatment, impairment certificate, caretaker and has not change of house because of disability.

Table D.3. Probability of receiving benefits being healthy (sample B0)[a]

	Men		Women	
	Coef.	t	Coef.	t
Constant	-1.021	-9.73	-1.524	-8.19
Age 50-54	0.141	3.00	0.079	0.96
Age 55-59	0.448	9.72	0.384	4.74
Married	-0.155	-2.78	-0.220	-2.38
Main breadwinner	-0.287	-4.69	-0.013	-0.14
Elementary	-0.208	-4.29	-0.299	-3.39
High School	-0.479	-8.00	-0.506	-4.82
College	-0.733	-9.80	-0.635	-5.44
Andalucia-Ceuta-Melilla	-0.110	-1.30	0.081	0.51
Aragon-Navarrra-Rioja	-0.199	-2.05	-0.062	-0.34
Baleares	-0.268	-1.90	-0.204	-0.79
Canarias	-0.457	-3.61	-0.796	-2.26
C. La Mancha	-0.298	-2.82	-0.144	-0.68
C. León	-0.280	-3.07	-0.228	-1.26
Cataluña	-0.347	-3.66	0.078	0.48
Extremadura	-0.204	-1.67	-0.406	-1.28
Galicia	-0.268	-2.75	-0.284	-1.54
Madrid	-0.459	-4.11	-0.348	-1.64
Murcia	-0.275	-2.04	0.077	0.35
País Vasco	-0.340	-2.98	-0.090	-0.45
C. Valenciana	-0.214	-2.14	-0.075	-0.41
N		16980		7491
Log Likelihood		-2708.02		-791.95
pseudo R^2		0.0668		0.0704

[a] Omitted categories: age 45-49, no education and living in Asturias or Cantabria.

Table D.4. Marginal probabilities of receiving benefits being healthy (sample B0)[a]

	Men			Women		
	45-49	50-54	55-59	45-49	50-54	55-59
Baseline	.1536	.1894	.2832	.0637	.0742	.1271
Living in Madrid	.0694	.0902	.1509	.0306	.0365	.0684
Married	.1198	.1504	.2333	.0405	.0479	.0869
Main breadwinner	.0954	.1216	.1948	.0621	.0724	.1244
Elementary	.1094	.1382	.2172	.0341	.0405	.0750
Secondary	.0668	.0870	.1463	.0212	.0255	.0499
College	.0397	.0534	.0958	.0154	.0187	.0379

[a] Baseline: single, no breadwinner, no education, and living in Asturias or Cantabria.